Space Weather Technical Forecast

Issued on Sunday, 09 April 2023 at 12:15 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-class flares (R1-R2 Minor-Moderate radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with peak flare of C9.1 09/0609 UTC from AR3272 in the southeast. This region consists of a number of small and relatively ragged spots, however recent growth appears to have stalled with a potential maturing of the region now occurring. There are two other unnumbered and new sunspot regions, in the northeast and southeast quadrants. These are currently small and relatively simple, however rapid flux emergence is currently being observed in the northernmost one. There are a number of filaments on the Earth-facing disc, All recent eruptions have been off the Earth-Sun line however, with no Earth-directed CMEs observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar wind speed as measured by ACE at L1 was at background, below 350km/s throughout. The density was also below average, resulting in anomalous readings from DSCOVR. The total IMF, Bt, was weak, persisting below 6 nT, with the north-south component, Bz, varying between +5 nT and -5 nT. The Phi angle was generally negative (towards the Sun). Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as measured at GOES16, was at background. The high energy electron flux (greater than 2MeV), as measured at GOES16 was initially High with a peak of 2510pfu at 08/1515 UTC, before falling to Moderate from 08/2000 UTC. The associated 24 hour fluence was below the Active threshold. The 09/0000 UTC observed fluence was 7.75e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with an ongoing chance of M-flares (R1-R2 Radio blackouts) most likely from AR3272 in the southwest disc.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs, with the filament eruption from around 07/0800 UTC expected to miss, passing ahead and to the south of Earth later day 3 or 4 (11-12 Apr). Although there is a very slight chance of a glancing influence. Current background slow-winds are expected to persist until later on day 2 or into day 3 (10-11 April), when the arrival of the fast wind associated with the HSS of CH91/+ is possible. This is expected to bring only a muted enhancement to conditions, with slightly elevated winds. Geomagnetic activity is expected to be mainly Quiet day 1 (9 Apr), with a chance of rising to Unsettled with Active periods later day 2 (10 Apr) but more likely on day 3 (11 Apr). Activity then easing day 4 (12 Apr)

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is expected to persist at background levels. High energy (greater than 2 MeV) Electron flux will continue to be mainly Moderate with diurnal peaks of High possible, but with an overall declining trend. A more notable dropout is expected with the arrival of the fast winds later day 2 or day 3 (10-11 Apr). The associated 24 hour fluence is expected to remain below the Active threshold.

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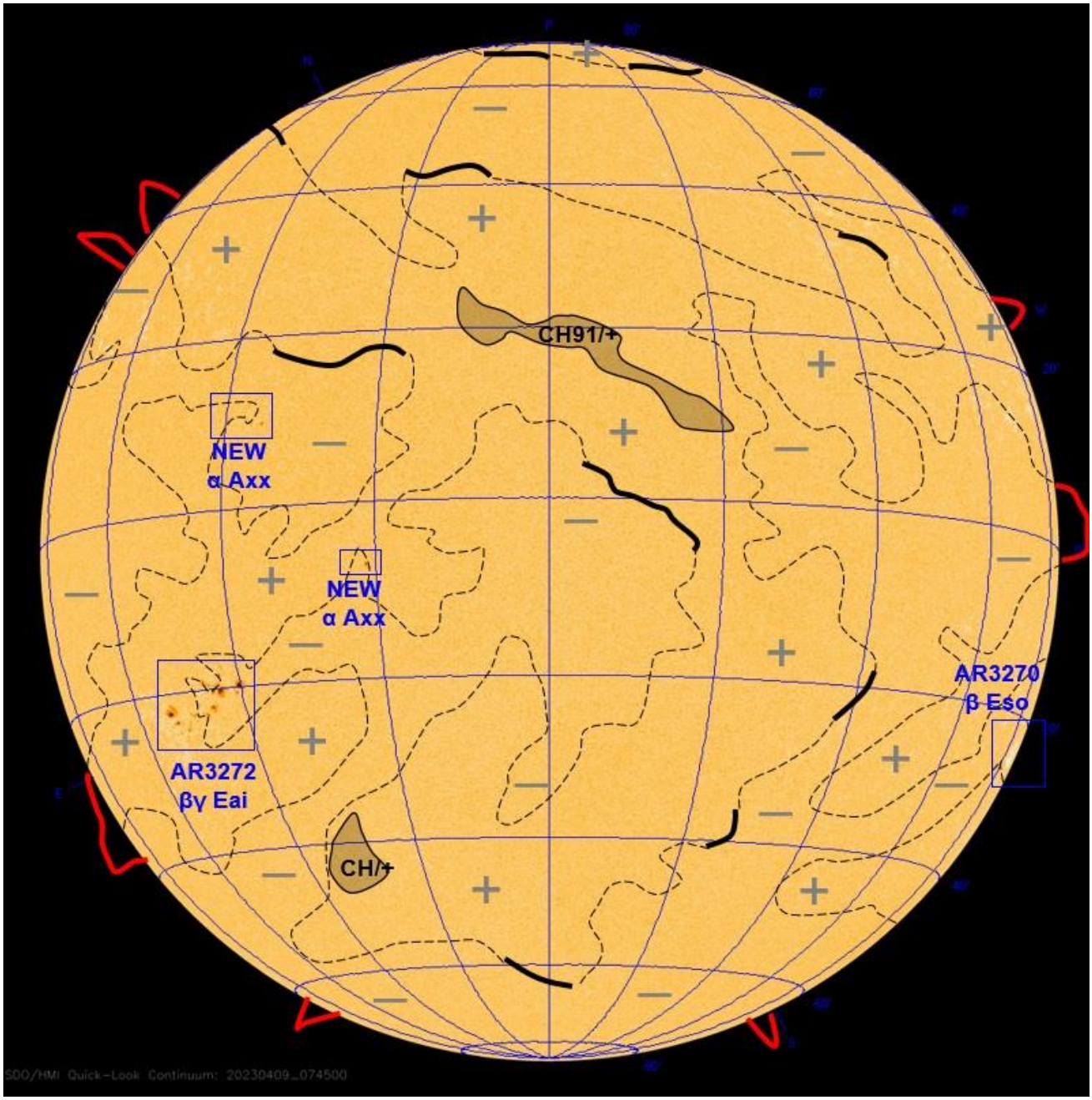
Figure 1. Solar Analysis Valid 09/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth-directed CMEs expected. Although a slight glance cannot be ruled out from the 07 Apr filament eruption late on the 11th or early 12th, however this is likely to miss, passing ahead and south of Earth.

Current background slow-wind conditions are expected to persist until the potential arrival of any fast wind associated with the high-speed stream (HSS) of CH91/+. This may begin to influence the solar wind regime as early as day 2 (10 Apr) but more likely day 3 (11 Apr). This feature is largely obscured in SDO imagery due to magnetic looping to its south, along with its narrow latitudinal width. However it is longitudinally wide, with any connection to its fast wind likely to persist for number of days.

27-day recurrence of this feature suggesting the potential for slightly elevated speeds of between 450-500 km/s. However, as a positive polarity coronal hole, this is not favoured for a strong connection close to the March equinox (Russell-McPherron effect), with only relatively subdued geomagnetic activity expected. Furthermore, enlil currently keeps any fast wind above Earth, leading to low confidence for even a weak connection to occur.

Geomagnetic activity is expected to be mainly Quiet day 1, with a chance of rising to Unsettled with Active periods later day 2 (10 Apr) but more likely on day 3 (11 Apr). This includes the potential for any glancing CME interaction. Any geomagnetic activity should ease back towards Quiet through day 4 (12 Apr).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	5	10	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
08/0107	Partial	Filament	SW	388 km/s	Missing	Passes 1AU around 12/0000 UTC

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Figure 2a: Solar Wind Persistence Model. Has weak arrival on 10th, and stronger enhancement on 11th, although this later one may include some CME contamination from the previous rotation.

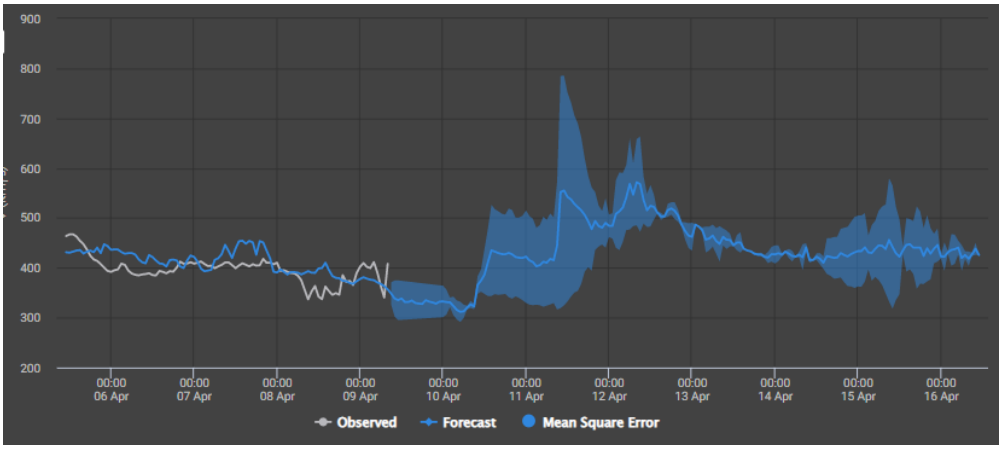
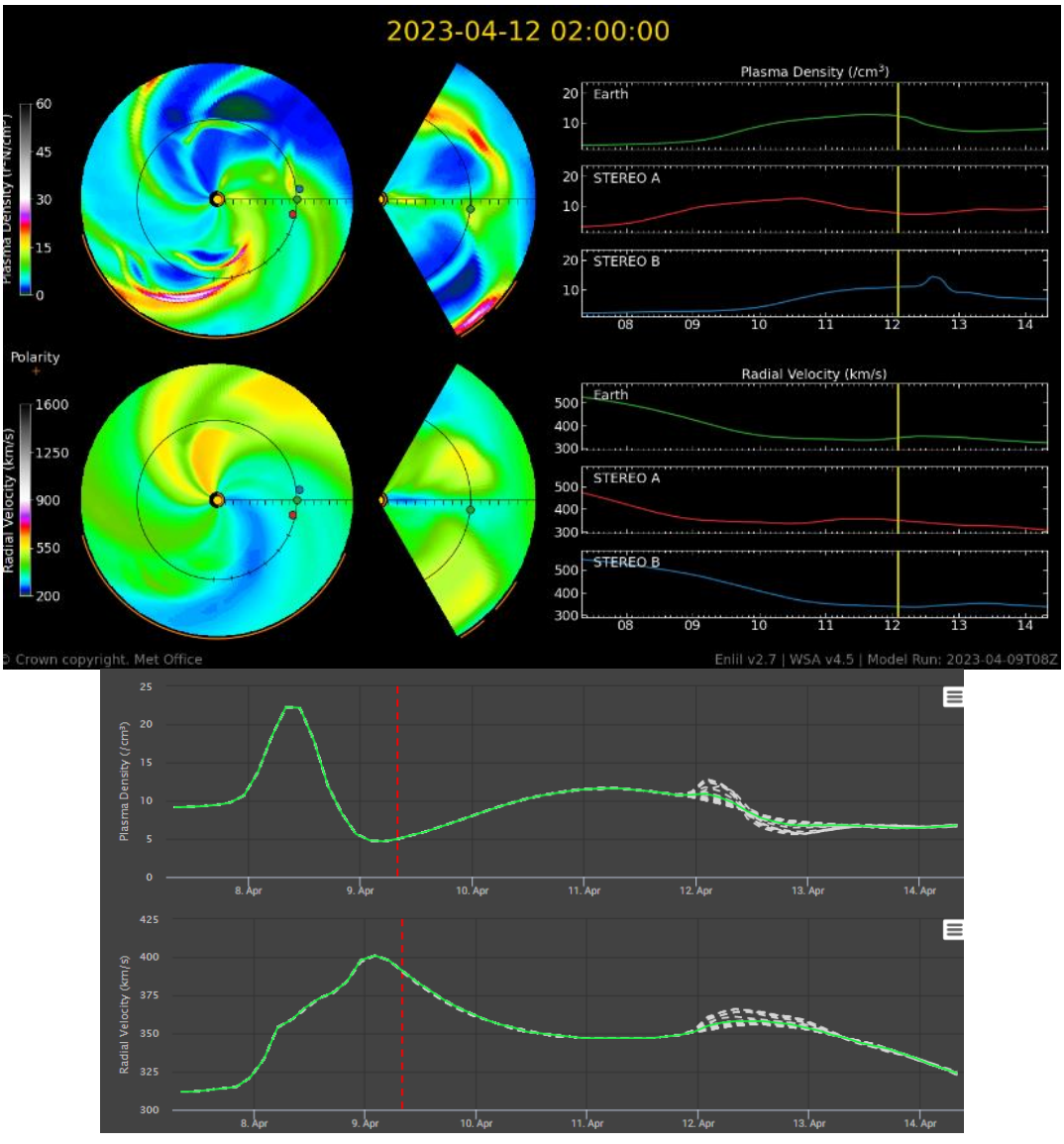


Figure 2b: Enlil and ensemble



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Radio Blackouts - X-Ray Flares:

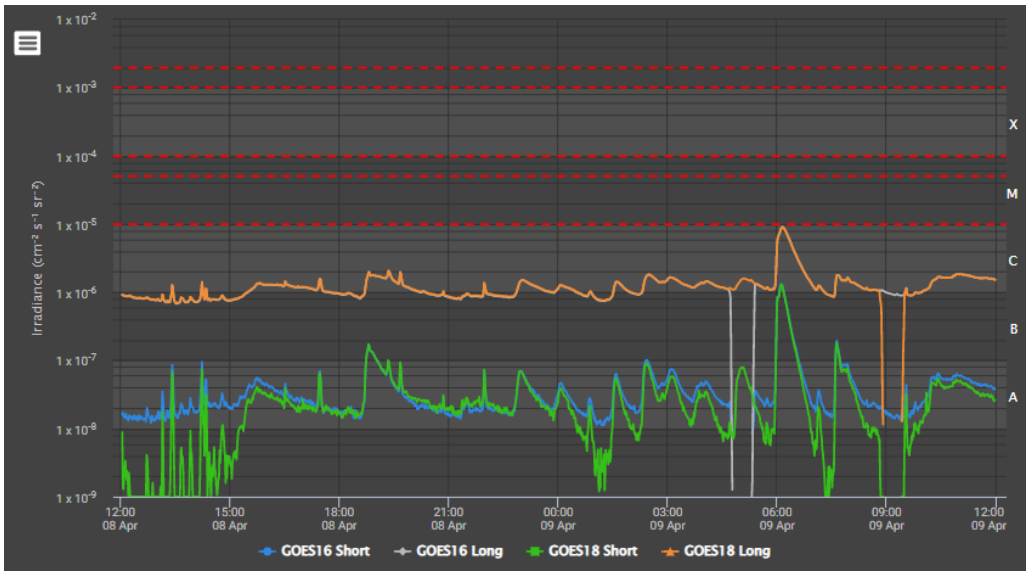
Low to Moderate activity is expected with an ongoing chance of isolated M-flares, primarily due to AR3272 Eai/Beta-Gamma, but also a potential from other developing regions or regions rotating onto the disc.

There are currently three regions on the disc, with AR3270 now rotated over the western limb and onto the far-side, but two small regions developing in the east disc. The main source of activity is likely to be from AR3272 which has a history of producing isolated M-flares on 07 and 08 Apr. This region has seen its growth largely stall with a fairly ragged appearance to its penumbral regions, however this still maintains some complexity wit SDO imagery showing a dense collection of magnetic looping.

Further sunspots regions also have the potential to rotate onto the visible disc, with looping also evident over both the northeast and southeast limbs, which would be coincident with signals on far-sided products.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: GOES-16/18 X-ray Flux



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux (greater than 10MeV), as observed by GOES-16, is currently expected to remain at background through the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4a: SDO hmi-intensitygram and magnetogram of AR3272

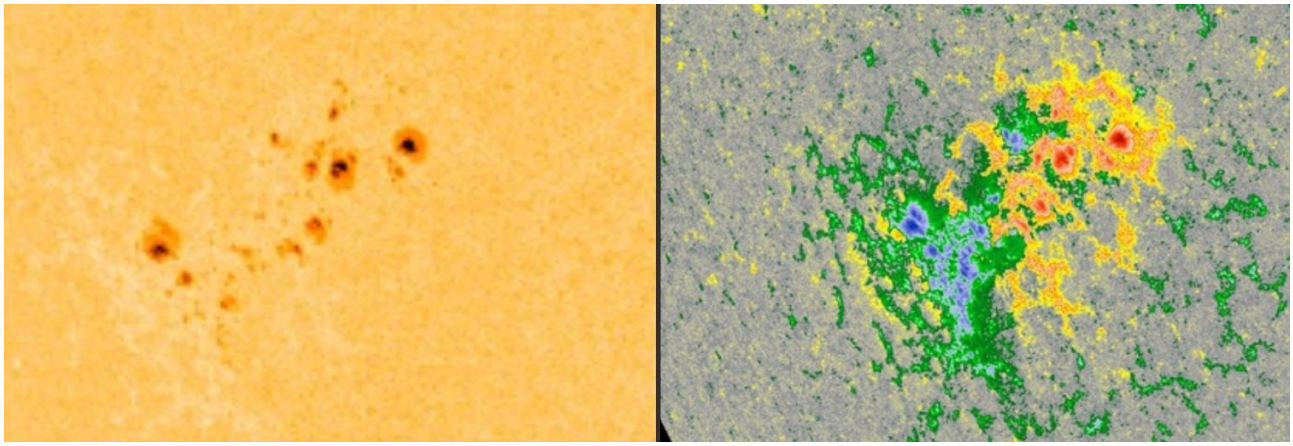
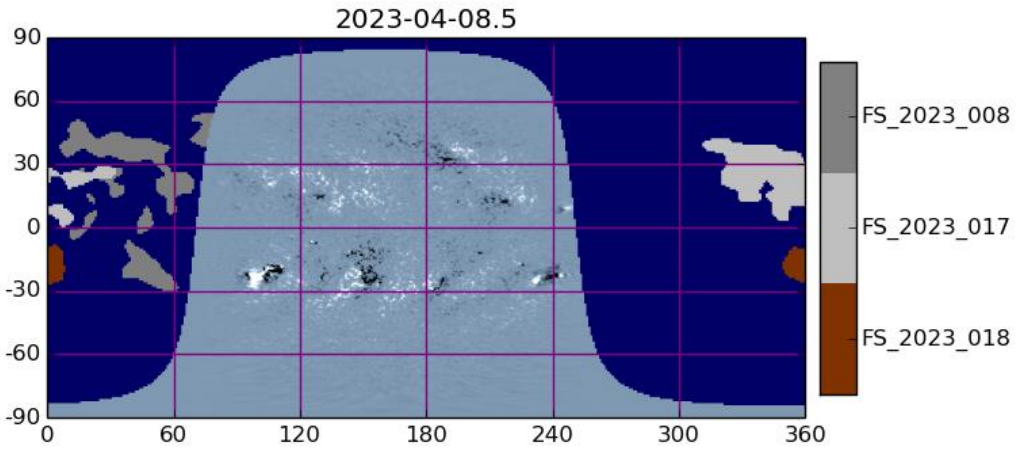


Figure 4b: JSOC far-side helioseismic image showing potential new regions to rotate on.



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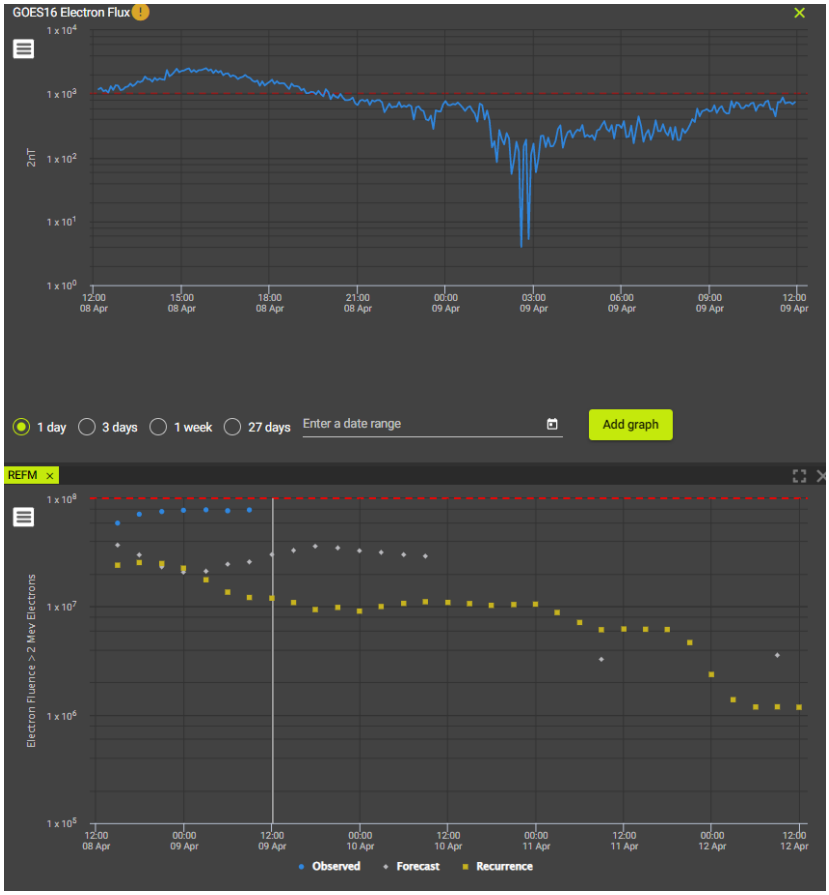
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2 MeV) as observed by GOES-16 is forecast to be mainly Moderate, but perhaps reaching High levels at diurnal peak periods. A general but erratic declining trend is expected before a more notable dropout occurs later day 2 and day 3 (10 and 11 Apr) due to the arrival of the HSS of CH91/+. A recovery of flux is possible on day 4 (12 Apr), however this is very low confidence with only a weak connection to the HSS expected.

The associated 24 hour fluence is expected to be remain below the Active threshold, with a decaying trend expected. This is supported by REFM which is giving good guidance. There is the potential for fluence to rise slightly day 4 (12 Apr) dependent upon the strength of any connection that occurs to the HSS.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: GOES-16 >2MeV Electron Flux and Fluence with REFM



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